Appendix A: Management Regime Design

Appendix A: Management Regime Design

This appendix elaborates on certain aspects of the management regime alternatives introduced in Section 2.1.1.

A.1.0 Regional Area Restrictions

A.1.1 Discussion and Options

The term "regional area" is being used to distinguish area management system based on depth (e.g. rockfish conservation areas) from those based on latitudinal divisions (regional areas). References in this section to "areas" are references to regional areas unless otherwise noted.

The question has been raised as to whether or not an individual fishing quota (IFQ) program might increase the need for regional area management to address biological or socioeconomic concerns. Without area management, it has been suggested that under an IFQ program there may be a greater potential for effort to be concentrated within some areas than there would be under other types of catch control tools. While the need for area management has been raised in the context of an IFQ program, it may also be an issue that should be addressed with respect to the use of non-IFQ catch control tools. Assigning area-specific optimum yields (OYs) may prevent regional depletion of stocks, which is an issue of biological concern to the extent that mixing or migration of stocks between areas is not occurring. Maintenance of fishing opportunities and protection of local community interests and processing infrastructure could be potential socioeconomic reasons for dividing OYs by area. Key objectives of regional area management include:

- Prevent regional depletion[1/] and set catch levels for areas based on stock assessments.
- Distribute economic benefits of catch along the coast.
- Ensure that certain communities receive economic benefits.

Regional area restrictions could be achieved through restrictions on catch area or landing area. Area OYs could be based on existing International North Pacific Fishery Commission (INPFC) boundaries or some other area distribution scheme. Catch area restrictions on IFQs would more precisely address biological concerns and would likely keep landings more geographically dispersed than might be the case without such restrictions. Landing area restrictions on IFQs would more precisely address socioeconomic concerns and would likely keep catch more geographically dispersed than might be the case without such restrictions. Another approach for addressing local socioeconomic needs would be a Community Development Quota (CDQ) program, similar to those developed in Alaska to protect communities heavily dependent on fisheries as their sole or primary economic activity. CDQs are a different type of IFQ provision or program, distinct from the area management provisions addressed here.

1/ The term "regional" depletion is being used here to denote broader scale depletion of a segment of a stock, and "localized" depletion is being reserved for concerns related to depletion of reefs or other relatively small geographic areas. IFQs established for INPFC management areas might prevent regional depletion but would not address localized depletion of biomass on a particular reef or in the area of a particular port.

TIQC Recommendation: Area restrictions should be based solely on the need to address stock conservation concerns.

Minimizing restrictions, such as catch area restrictions, will increase operational flexibility and increase the value of the IFQ. Given flexibility, vessels will go to areas where they can fish the cleanest.

Landing area endorsements should be rejected. With respect to protection for ports, the TIQC felt that there are not enough groundfish to support processing facilities in every port that has historically had such fisheries. The economics of the trawl fishery do not allow vessels to travel far from the fishing grounds to deliver their catch. Where fish should be landed cannot be accurately forecasted and is worked out through negotiations between vessels and processors. The potential for geographic redistribution is a reality for market driven systems. Nothing in the current system prevents vessels from migrating between ports.

TIQ Enforcement Group Recommendations: If some IFQ are catch area specific, then all landings should occur in ports within the catch area. This implies that a vessel would not be able to fish in two catch areas on the same trip. However if the enforcement system includes vessel monitoring system (VMS), compliance monitors, and full retention, it may be possible to allow vessels to fish in two areas on a single trip, as long as the catch for each area is kept separate.

Options from Public Comment Period:

Option	Source
Landing or catch area specific IFQ based on biological and socioeconomic need	ED, Survey (ED)

A.1.2 Initial Analysis

To date, management of West Coast groundfish on a spatial basis has only been done on a fairly coarse scale. Alaska and British Columbia groundfish fisheries use some form of allocation by area to ensure catches are distributed in proportion to available biomass.

There is a significant amount of evidence that population structure of many species of groundfish (rockfish in particular) is complex and genetically fragile. Preservation of age class structure appears to be important as recent studies indicate older fish may produce more viable larvae. There is evidence in the literature and from stock assessments that the age structure of groundfish species has been truncated and that growth and maturity of some species has been affected (Francis 2003). To rebuild populations, rebuilding plans have been developed for species known to be overfished. Some of the measures taken should have the effect of restoring population and age structure for overfished and associated species. Reducing uncertainty in stock assessments is key to ensuring reduced risk of assessment errors and thus long-term viability of fisheries. This might be accomplished through cooperative arrangements between industry and government to finance and better utilize and extend (spatially) fishery and research data used in stock assessments (Walters and Pearse 1996).

Allocation of catch by area could help protect stocks with susceptible population structures. Management measures other than area specific IFQs, some of which are already in place, may provide stock structures with some protection from or resiliency to regional depletion A closure during spawning might ensure that all potential successful parents have the opportunity to spawn during a given year. However, they would remain vulnerable during open periods, and unless access to certain areas were restricted, the risk of excess fishing mortality on potentially successful parents would remain to the degree fishing effort was concentrated in a particular area. Reduced overall fishing mortality would be another means of helping to protect the age class structure. Both population and age structure could be conserved through a network of marine reserves. In order to design an effective network of marine reserves, more information is needed for various species on the effective population size, larval contribution, and recruitment patterns. Larson and Julian (1999) argue that fisheries management should account for spatial unpredictability in spawning success by "spatial bet-hedging" through measures such as no-take areas. If fish populations are composed of groups of spawners whose success in producing recruits is variable and spatially distributed, representative areas would need to be protected throughout their range to ensure some parents in any given year (the "sweepstakes winners"[2/]) would make a contribution to future recruitments. The authors suggest more information is needed to determine the spatial scale of genetic patchiness, and that this information would help design marine no-take areas to protect population structures geographically. Current riparian conservation areas (RCAs) provide some protection for both population and age structure. Removal of these, along with removal of other controls used to reduce the possibility of concentrating fishing effort, may place some groundfish stocks at increased risk.

In addition to area restrictions, another input control, time restrictions, could combined with an IFQ program (Walters and Pearse 1996). In general, temporal and spatial restrictions alone tend to undermine efficiency gains and may continue to do so under an IFQ program if shareholders are forced to compete for local concentrations of fish within restricted windows of opportunity (Walters and Pearse 1996). This would run counter to one of the benefits sought through creation of an IFQ program, an increase in efficiency as a result of reduced regulatory encumbrance of vessel harvest activities.

Status Quo West Coast, Alaska, and British Columbia Regional Area Management

West Coast groundfish management uses a variety of input and output controls to regulate the fishery (PFMC 2004e). Although the areas are large, these management tools imply some measure of temporal and spatial control. Some of the following controls that are currently in place may be relaxed under a trawl IQ program:

2/ Genetic patchiness in marine populations may be explained as a "sweepstakes-chance" model proposed by Hedgecock (1994). Hedgecock argues that observed genetic heterogeneity on a microgeographic scale may result from temporal variation in the genetic composition of recruits. Furthermore, he argues that this variability could be due to selection on larval populations or large variations in the reproductive success of individuals whereby successful parents match reproductive activity with favorable windows of oceanographic conditions that promote fertilization, larval development and retention, and recruitment.

- Allocation of OY by area for certain species.
- Differential Trip Limits - Differences exist in cumulative trawl trip limits north and south of 40°10' N latitude. Cumulative limits reflect differences in opportunities due to distribution of OY north and south and their potential to be realized. In addition, the need to protect overfished species constrains the take of co-occurring species and these constraints vary north and south.
- License Limitation - Current participation has been reduced by the vessel buy-back program. Processor consolidation has occurred. Thus, with fewer boats and fewer processors, the ability to catch and process fish has been concentrated among remaining fleet and ports. Under an IQ program further concentration may occur through rationalization and specialization of activities.
- Rockfish Conservation Areas - Tight restrictions in large areas within bathymetric ranges established to protect overfished rockfish. These may provide marine reserve-like protection to the population and age structure.
- Selective trawl designs - Recent development of more selective gear (with respect to bycatch of overfished rockfish) has allowed vessels to harvest flatfish in the northern area while minimizing the take of overfished species.

Very few of the annual OYs are subdivided by area under current management of the West Coast groundfish fishery. When OYs are subdivided for some species, the split is usually made north and south of 36° N latitude, north and south of 40°10' N latitude or by INPFC area.

In Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI), total allowable catches (TACs) are established for individual species and species complexes based on biomass distribution to prevent regional depletion (Witherell 1995). Flatfish TACs are typically set lower than acceptable biological catch (ABC) levels to protect the available bycatch for valuable trawl fisheries for pollock, Pacific cod, and rockfish. TACs may be set for specific smaller regulatory areas, particularly in the GOA, to distribute catch and effort in proportion to biomass distribution. These sub-areas are comparable in size to INPFC areas used to manage the West Coast groundfish fishery.

The Canadian government uses an area allocation scheme (DFO 2004). Stakeholders in British Columbia (BC) were concerned that the quota trawl fishery entitlement and tradable quota shares could allow concentration of effort. Without area allocation, shareholders could concentrate on highly valued species in areas close to home ports. If weaker stocks are caught incidentally with these target species, concentration of shares to enable access within these areas may lead to depletion and or serial depletion of some species. BC's area allocation of TAC was done for biological reasons and in the absence of clear-cut stock information. Thus area allocations there are a precautionary measure to prevent excessive concentration of fishing effort, overfishing and regional depletion of fishing resources, especially near fishing ports.

British Columbia's TAC is allocated by Pacific States Marine Fisheries Commission (PSMFC) areas for their groundfish fisheries, including the trawl IQ fishery. PSMFC areas are about 1/3 the size of INPFC areas. The major groundfish ports include Prince Rupert (northern mainland), Vancouver and Richmond (southern mainland), Ucluelet (West Vancouver Island), and Port Hardey (Northeast Vancouver Island).

Total allowable catch for quota species is set either coastwide, or based on subareas, or groupings of subareas (Figure A1 and Table A1). The proportion of TAC assigned by area was determined

from a variety of sources including stock assessments, knowledge of stock genetics, tagging studies, physiogeography, catch and effort data, and advice from fishers with detailed knowledge of fishing grounds. To the degree stock information was available, area allocation was used to prevent overfishing within subareas and to achieve yields proportional to the productivity of these areas. In some cases, management boundaries were adjusted as a consequence of the process of review and analysis used to determine area allocations. The robust observer program Canada employs collects additional biological data on species composition, concentration, and distribution. Department of Oceans continues to review biological data and determine the appropriateness of area allocations.

Comparisons between the Canadian system of TAC allocation by area and alternatives proposed under the West Coast TIQ program should be made with caution. British Columbia's groundfish management area is geographically much different and much smaller than the Washington, Oregon, and California (WOC) management area. British Columbia has fewer ports and most are concentrated in the southern part of the management area. Considerable effort went into designing British Columbia's area allocation scheme, involving scientists, managers, and representatives of the fishing industry. At least as much effort would be required to develop such a scheme for the WOC management area.

Potential for Geographic Shifts Under an IFQ Program

The potential for geographic shifts may be evaluated by looking at likely effects of changes in the management system on factors affecting the existing distribution of harvest and past tendencies for harvest to shift between regions.

Influence of Management System Changes on Distribution of Fishing

The ability to divide and transfer quota shares under an IFQ system will increase the likelihood that fishing activities will be responsive to influences in the natural and socioeconomic environment. The distribution of landings along the West Coast is the aggregate result of individual decisions on whether or not to participate in the fishery and if so at what level and location. Different management systems present a different suite of opportunities, incentives, and barriers for those entering or expanding their activities as well as those contracting or quitting. Effects of factors influencing the distribution of harvest activity are muted and harvest distribution may be geographically smoothed out under the current management system with its indivisible permits and trip limits. IFQ programs can provide relief from the “all or nothing” choice constraint presented by the license limitation system. Relief from regulatory constraints under a revised management program may also result in a redistribution of catch. Potential relief from constraining trip limits include IFQs programs, capacity reduction programs and stock rebuilding programs. While the degree and direction of shift is not predictable, the likelihood of changes in the geographic distribution of fishing activity is greater under IFQs than under the current system.

Numerous factors influence the distribution of harvest, including relative profit opportunities (affected by factors such as catch per unit effort (CPUE), port costs, exvessel prices, local labor costs etc.). Under IFQs, harvesting profits or rents tend to be higher since participants are better able to employ their capital and schedule harvests in order to maximize the value of their landings. Opportunities to improve efficiency under IFQs is likely to vary between ports. Social and

climatological factors also influence participation decisions. These factors are discussed in detail in Appendix H (page H-91).

Interviews with stock assessment scientists indicated that current management has not directly limited concentrations of fishing effort. Some felt that designing an IFQ system without area allocation of OY may not be a significant issue as effort does shift around anyway, and declining CPUE would lead to compensatory fishing behavior that would result in changes in fishing location. However, as discussed above, factors other than the CPUE for a particular species also affect distribution of harvest, for example, port costs, grounds familiarity, CPUE for a complex (as distinct from that for an individual stock), exvessel prices, and social connections to a particular port.

Geographic Shifts Observed Over Time

The degree to which harvests and landings have shifted in the past in response to changing conditions may provide information about the likelihood of future shifts. Geographic shifts reviewed hear include stock biomass, CPUE, catch areas and landing areas.

Except for the recent application of depth and area-specific management, the geographic distribution of groundfish fishing effort on the West Coast has not generally been directly constrained by regulations. There has been some latitudinal shift of harvest over time, however, it is not apparent that fishing effort necessarily follows high survey biomass or CPUE under the current management system. Maps of survey biomass for lingcod, sablefish, and Dover sole show more variation in relative concentration over time than with latitude. Maps of historical catch exhibit variability over time with some changes over latitude, but these trends do not generally follow those indicated by the biomass surveys (see Appendix H to this document, Figures 2-7 from the Groundfish Trawl Individual Quota Analytical Team Report, October 2004).

There is evidence that environmental drivers may cause spatial and temporal changes in pelagic and demersal groundfish distributions. A study of groundfish in the Gulf of Alaska found that the distribution of adult and juvenile groundfish was structured primarily along depth gradients, apparently related to differences in upwelling between the eastern and western Gulf of Alaska (Mueter 1999). NMFS triennial trawl surveys off the WOC management area have been used to characterize spatial attributes of groundfish (Gabriel and Tyler 1980; Weinberg 1994). A study of groundfish off Oregon and Washington also found persistent groundfish assemblages along depth gradients and concluded that logbook data could be used to augment triennial trawl survey data to better characterize spatial and temporal distributions of groundfish (Lee 1997).

Potential Biological Effects of Regional Depletion

On the one hand, stock distribution may shift in response to environmental drivers, on the other, fishing mortality can be expected to produce measurable changes in distribution, abundance, and age structure of marine fish populations. In the latter case, the degree of change depends on the intensity of fishing effort with respect to catchability (fraction of population removed per unit of effort) and productivity of the stock, as well as the degree of movement of the species being fished. There is concern that if regional depletion occurs in heavily fished areas, the productivity and genetic structure of the stock may be adversely affected and consequently ecosystem relationships.

Available data and current models limit our ability to understand how stocks and their assessments are potentially affected by localized changes in fishing activity resulting from management measures such as marine protected areas (MPAs), RCAs, area OYs, or IFQs. Current stock assessments assume homogeneous distribution of the fish populations and free mixing across the region being assessed. Current models do not yet have the needed data or capability to incorporate spatial structure such as mixing, moving, and dispersal rates. Impacts of area management tools such as MPAs on stock assessments are only beginning to be evaluated (Punt and Methot 2004). Stock assessment scientists surveyed felt it could be difficult to detect potential changes without improvements in sampling and modeling. If regional changes are significant but not anticipated or detected, there could be unexpected adverse consequences for the stocks and ecosystem.

With an increase in overall mortality, a reduction in age classes can be anticipated (Gulland 1977). Studies done within the last two decades have documented ecological effects associated with intense fishing pressure such as the removal of top predators, reduced biodiversity, and habitat impacts (Francis 2003). More recent work on recruitment dynamics and population structure also have implications for both temporal and spatial management of groundfish.

There is a growing body of evidence that suggests many species of groundfish have a complex and subtle stock structure that varies by geographic region within the WOC management area. Miller and Shanks (Miller and Shanks 2004) examined otolith microstructure and microchemistry of black rockfish and found evidence that larvae from different locations did not mix during ontogeny and possibly did not disperse long distances latitudinally. The authors estimated larval dispersal distances to be much shorter (<120km) than previous estimates based on models of passive dispersal. Smaller mean dispersal distances imply the need for spatial conservation of adults producing the larvae - especially if the species is overfished. Most groundfish stock assessments assume that the genetic structure of the assessed species is panmictic - that is the stock is fully mixed and members from all geographic regions regularly interbreed and that populations are homogenous, or if there is evidence of separate stock structure these differences are ignored as input data are typically not fine enough to conduct stock assessments on separate sub-stock components. In the past, larval dispersal mechanisms theorized based on ocean currents tended to support this view in that passive dispersal occurs over fairly large distances. The new evidence suggesting that populations may be more isolated increases the probability that potential regional depletion may adversely affect a stock and may need to be accounted for in the management regime.

Berkeley (Berkeley *et al.* 2004) reviewed stock status, population age and genetic structure, and management implications, citing examples from the West Coast groundfish fishery. The authors presented evidence of stock structure on a finer scale than is typically assumed in stock assessments. They argue that truncation of age structure within rockfish populations in particular may lead to reduced larval viability and survival - older black rockfish appear to spawn earlier (Bobko and Berkeley 2004) and produce more viable larvae (Berkeley 2004). While not a West Coast groundfish, older female Atlantic cod (*Gadus morhua*) also appear to be more reproductively successful than younger females (Murawski *et al.* 2002). Berkeley (Berkeley *et al.* 2004) conclude that both spatial structure and age structure are important for long term viability of a stock

Other genetic evidence also suggests finer and more complex population structure for rockfish, in particular. Withler et al.(2001) through microsatellite DNA studies affirmed earlier work by

Gunderson (1972) which identified two populations of Pacific ocean perch (*Sebastes alutus*) within Queen Charlotte Sound, British Columbia. Withler et al. (2001) separated Eastern and Western Queen Charlotte Island (QCI) stocks and a Vancouver Island stock. An interesting feature of this finding was that the QCI stocks overlapped latitudinally - distance did not appear to be a factor in the degree of genetic isolation. The study supports other findings that many marine populations, in spite of their potential to reach large population sizes, are fragile due a high degree of genetic variability, longevity, slow growth rates, and to episodic recruitments influenced by environmental changes (Grant and Bowen 1998) and (Fitch 1969). The authors concluded that separate management would be advisable to conserve the spatial integrity of Pacific ocean perch.

Copper rockfish (*Sebastes caurinus*), a benthic, nearshore species with a high degree of site fidelity, was found to be genetically divergent between Puget Sound and coastal stocks (Buonaccorsi *et al.* 2002). Furthermore, genetic divergence along the coastline was also significant suggesting isolation between regions even though larvae drift for up to 3 months prior to settlement. The authors suggest a pattern of recolonization since the last glacial period (14,000 years ago) and more limited realized larval dispersal, due to oceanographic barriers such as recirculating oceanographic currents and mesoscale eddies along with potential unique larval behaviors that may tend to counteract dispersal over large distances through passive drifting.

In summary, recent evidence suggests that some groundfish stocks may have a more complex population structure and greater geographic isolation than previously thought. Current models are based on assumption of greater population mixing between geographic areas; and limits on the available data inhibit development of models that would help us better understand how stocks and their assessments are potentially affected by localized changes in fishing activity. If regional changes are significant but not anticipated or detected, there could be unexpected adverse consequences for the stocks and ecosystem.

Examples of Regional Depletion

In a few examples of West Coast groundfish and fisheries elsewhere there is evidence of regional depletion that supports the need for spatial management. Current west coast groundfish stock assessments generally assume a large degree of homogeneity in stocks of groundfish - due in part to the problem of distribution of catch and biological data and the inability to conduct stock assessments on a finer spatial scale than coastwide. Thus, there is limited documented evidence of regional depletion for most species of groundfish (lingcod being an exception, but still only known to be depleted within context of a very large spatial scale), however, there has not been sufficient analytical capacity or effort applied to determine whether it is taking place. Anecdotal information from fishermen who have been long time participants in West Coast fisheries suggests that species such as Pacific ocean perch, canary rockfish, and black rockfish, to name a few, were more broadly distributed in the past than they are currently.

On a large spatial scale, the collapse of the Atlantic cod (*Gadus morhua*) stocks reflected some characteristics of regional depletion. Temporal and spatial changes in abundance were noted in this fishery as stocks declined to overfished levels steadily beginning in 1962 (Hutchings and Myers 1994). The cod stocks were thought to have been significantly reduced by trawling in the 1970s.

Harvest of cod offshore of Newfoundland and Labrador using gill nets began following the sharp decline in inshore gillnet landings between 1982 and 1985. Increases in gill net catches were coupled with declining catch rates. Catch rates declined both inshore and offshore, thus indicating a sequence of serial depletion. During the stock decline, technological improvements permitted the fleet to continue to locate and exploit remaining stocks at ever increasing rates of fishing mortality.

On a much smaller spatial scale, Mason (Mason 1995) analyzed species trends in sport fisheries occurring withing the Monterey Bay area between 1959 and 1986. Most of the fish were taken by more mobile commercial passenger fishing vessels (CPFV) and a smaller more local skiff fleet. Early in Monterey Bay's fishing history, abundant species were targeted by both fleets closer to port. Mason found that as effort increased, the catch of certain nearshore rockfish species (genus *Sebastes)* taken primarily by the skiff fishery declined and species composition changed to reflect declines in populations of the most abundant species. Commercial passenger fishing vessels moved further offshore to target on more abundant deepwater species. Fishing pressure and variable recruitment were cited as reasons for a decline in blue rockfish (*Sebastes mystinus*) formerly sought inshore by the skiff fleet, and in more distant shallow reefs targeted by CPFVs. With a reduction in blue rockfish abundance, CPFVs began targeting semi-pelagic yellowtail rockfish (*Sebastes flavidus*) over deeper water reefs, then shifted to a still deeper water complex of *Sebastes* species further offshore. Mason cited rockfish life history characteristics such as residential behavior, variable recruitment, and natural longevity as sources of vulnerability to local overfishing for several species. Further, he concluded that the high site fidelity exhibited by nearshore species in particular, made them particularly vulnerable. Other studies cited by Mason indicated that many nearshore species (blue rockfish and olive rockfish (*Sebastes serranoides*) move less than a kilometer or two from reefs, while more pelagic species such as yellowtail rockfish may move more than 25 km.

Enforcement and Other Management Concerns

Enforcement problems related to transiting and fishing in multiple areas on a single trip must be addressed in the design of any enforcement and monitoring program that includes catch area restrictions.

Recommendations

The contractor working on biological impacts for the TIQ scoping document included the following recommendations as part of his report.

1. Stock assessment scientists, fishery stakeholders, and managers should jointly evaluate whether or not area management will improve stock assessments, sustainability, and overall yield. If area management is found to be a preferred sub-alternative, then these participant groups should also be instrumental in defining management areas.
2. The boundaries for OY allocation could be based on OYs outlined in the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2005-2006 Pacific Coast Groundfish Fishery (PFMC 2004).

3. Available information on species characteristics (genetic structure, age structure, reproduction, and larval dispersal) could be used as a guide to establish boundaries and OYs for subareas within the WOC.
4. There should be a method by which catch-area IFQ can be created after the program is implemented, should the biological need for such area management be established. Also, thought should be given to whether there is a reasonable probability that management lines might need to be changed in the future and, if so, how those changes would be accomplished.

Summary

1. Making an informed choice for an IQ program can be facilitated by evaluating several sources of information, including a review of other area management programs, review of stock assessment data, spatial analysis of fishery and survey data, and analysis of habitat suitability maps in the Groundfish Essential Fish Habitat environmental impact statement (EIS).
2. There are several biological, economic, and social factors that may influence the distribution of fishing effort along the West Coast, potentially leading to concentration of effort and areas of localized depletion both under current management systems and a potential IQ system.
3. Effort has shifted in the past and would probably continue to shift under an IQ program but the likelihood of shifts under an IQ program may increase.
4. Recent studies of population and age structure and recruitment dynamics raise serious biological concerns about the potential for impacts from regional depletion.
5. Understanding potential impacts of an IQ system within areas smaller than current management or assessment areas may be difficult as little information exists to evaluate past or present fishery impacts by subarea. Changes in fishing strategies may also influence fishery-dependent data.
6. While the potential extent of adverse concentrations of effort is unknown, area management may be a useful precautionary tool to prevent overfishing within subareas of groundfish stocks. Current management measures (RCAs, selective gears, etc.) and new tools (finer area allocation, MPAs, etc.) could be employed as a precautionary measure to ensure proper spatial management to safeguard against local overfishing, and to conserve population and age structure needed to increase the likelihood of successful recruitment events, hedging against unpredictable spawning success. In particular, area management might be considered for species that have known problems of regional depletion (lingcod) or may have a high potential for regional depletion.
7. Research is needed on spatial sampling and modeling approaches for stock assessments. The degree of local overfishing is unknown - fishery and survey data and habitat information needs to be analyzed on a finer spatial scale to develop a better understanding of fishing and fish distribution patterns. Fishery independent and fishery dependent data sources could be incorporated into an ongoing monitoring program to evaluate the appropriateness of area allocation of OY.

A.2.0 Division of Trawl Sectors

A.2.1 Discussion and Options

The TIQC developed the following options for potential subdivision of the trawl sector. Under a given option, transfers of IFQ between subdivisions would not be allowed.

Division of Trawl Sectors				
Option 1:	One Trawl Sector			
Option 2:	Shoreside Deliveries		Mothership Deliveries	Catcher-Processor Deliveries
Option 3:	Shoreside Nonwhiting Deliveries	Shoreside Whiting Deliveries	Mothership Deliveries	Catcher-Processor Deliveries

(Note: the same divisions need not apply to all species)

TIQC Recommendation:
There is currently no consensus by the TIQC.

Public Comment:

Option:	Source
Include recreational fisheries and allow cross sector transfers.	UASC

A.2.2 Initial Analysis

In general, within the scope of the IFQ program (in this case the groundfish trawl fishery), the more transferability allowed among vessels the more efficient the use of the fishery resource and hence the greater the potential total economic benefits of the program. Limits on IFQ transfers among sectors, while limiting enhancement of overall economic efficiency, may be adopted to attempt to preserve certain characteristics of a fishery that may be considered desirable.

Option 1, by not differentiating between trawl sectors, would maximize potential transferability among trawl fisheries. Transferability and accompanying benefits decline with each successive option.

If IFQ is specific to individual trawl sectors and not transferable among sectors, rules will be needed for defining when a vessel is participating in a particular sector. Separating the various sectors under Option 2 (shoreside, at-sea catcher-processors, and at-sea motherships) is relatively straightforward in this regard since these subdivisions are already defined. Option 3 would require separating shoreside whiting from shoreside nonwhiting landings. Whiting is taken as incidental catch in trawl fisheries targeting other species. Prior to the primary whiting season, vessels are

currently allowed to deliver up to 20,000 pounds of whiting per trip.[3/] Currently, the Groundfish Management Team (GMT) uses 20,000 pounds of whiting as the criteria for separating shoreside whiting from shoreside nonwhiting landings. However, the development of new, higher value markets for whiting could depend on smaller landings. Therefore, the 20,000 pound rule may arbitrarily restrict such market development in an IFQ based whiting fishery. Examination of recent data from the whiting fishery revealed that all landings of less than 10,000 pounds were composed of either substantially more or substantially less than 50% whiting. Three options are under consideration:

	Criteria for a Whiting Trip		
Classification Option 1	>50% whiting	AND	>10,000 pounds of whiting
Classification Option 2	>50% whiting	OR	>10,000 pounds of whiting
Classification Option 3	>50% whiting		

The potential for whiting to become an incidental catch constraint for the shoreside nonwhiting fishery is higher under Option 3. Flatfish trawl is an example of a nonwhiting fishery in which incidental whiting catch could limit access to target species. For the nonwhiting fishery, Options 1 and 2 would provide relatively more access to the market for whiting IFQ to cover incidental landings than Option 3.

If the purpose of dividing the sectors is to maintain the status quo, is there a need to create divisions for the nonwhiting fisheries?

Dividing the fishery by sector may be deemed beneficial for social reasons. Restricting transfers of IFQ between sectors may help to preserve the existing structure of the fishing industry and communities. It would also prevent one sector from shutting down another by buying up the total allotment of a limiting bycatch species.

The need for incidental catch allowances to cover bycatch of certain limiting species is likely to fluctuate from year to year in each sector. Further subdividing incidental catch IFQ between sectors would create smaller and smaller available IFQ pools in a given sector. This would increase the likelihood that a sector may be constrained by insufficient quota for incidental catch species. The most efficient system would allow for maximum transferability of IFQ between trawl sectors.

3/ Following the primary whiting season the current limit drops to 10,000 pounds per trip.

A.3.0 Use of Other Gear by Limited Entry Trawl Vessels

A.3.1 Discussion and Options

This item concerns groundfish and other species caught by groundfish trawl vessels. With respect to groundfish, the issue is whether or not groundfish caught by trawl vessels using nontrawl gear should be included under the IFQ program. With respect to nongroundfish, the issue is possible retention of trawl prohibited species such as Pacific halibut. If prohibited species IQs are included under an IQ program (i.e., individual bycatch quota [IBQ] are created for prohibited species as part of decisions made in Section 2.1.1.6), then the question is How should catch of prohibited species be treated if trawl vessels take these species while using gear that is legal for those species? More specifically, can a trawl vessel use IBQ to retain trawl species fish if it uses gear legal for that species?

Trawl Vessel Catch of Groundfish With Nontrawl Gear

Under the allocation accounting system of the current license limitation program, all groundfish taken by vessels with groundfish limited entry (LE) permits count against the LE groundfish quota, regardless of the gear used. LE vessels may use open access gears in fisheries that target groundfish or take groundfish incidentally while harvesting non-groundfish species. Open access includes exempted gears (such gears as vertical hook-and-line and salmon troll gear) and vessels using longline or fishpot gear without a permit endorsed for those gears. Consequently, directed groundfish catch by LE trawl vessels using exempted or longline and fishpot gear under open access regulations counts against the LE allocation. Exempted gears include gears that take groundfish incidentally to effort targeted on nongroundfish species, such as pink shrimp, salmon or California halibut, and lands groundfish as incidental catch. Such incidental groundfish catch by LE vessels also counts against the LE allocation.

The following options have been identified with respect to use of IFQ for covering exempted gear catch. Underscored text indicates portions of the options which vary from similar options addressing trawl vessel use of longline or fishpot gear without a limited entry permit.

EXEMPTED GEAR OPTIONS: Application of IFQs to Limited Entry Trawl Vessels Using **Exempted** Gear **(e.g., vertical hook-and-line, shrimp trawl, California halibut trawl, salmon troll gear).**	
Option 1 - Require IFQ for Catch by Limited Entry Trawl Vessels Using **Exempted Gear**: IFQ tracking and monitoring rules would apply to limited entry trawl vessels even when using **an exempted gear.**	
SubOption 1A	Catch would be required to comply with **open access** fishery catch control regulations.
SubOption 1B	Catch would be allowed in excess of **open access** fishery catch control regulations, so long as landings are completely covered by trawl IFQ.
Option 2 - Require IFQ for Catch by Limited Entry Trawl Vessels Only When Using Groundfish Gear	
SubOption 2A	• Split the groundfish trawl allocation between IFQ and non-IFQ harvest • Maintain the Amendment 6 accounting system and use nonIFQ management measures to control catch taken by trawl vessels with **exempted gears**.
SubOption 2B	• Maintain the same limited entry allocation • Change the accounting system such that catch of limited entry trawl vessels using **exempted gears** counts against **the open access** allocation and apply **open access** catch control regulations.
SubOption 2C	• Reallocate a portion of the limited entry allocation to the open access sector • Change the accounting system such that catch of limited entry trawl vessels using **exempted gears** counts against **the open access** allocation and apply **open access** catch control regulations.

The following table illustrates how each of the above options would work for an LE trawl vessel using an exempted gear:

	Catch Counts Against	IFQ Must Be Held for Landing	Catch limits that apply
Suboption 1A	LE Allocation	Yes	IFQ and open access trip limits apply
Suboption 1B	LE Allocation	Yes	IFQ only
Suboption 2A	LE Allocation	No	Trip limits for LE use of open access gear apply
Suboption 2B	Open Access Allocation	No	Open access trip limits apply
Suboption 2C	Augmented Open Access Allocation	No	Open access trip limits apply

LONGLINE AND FISHPOT OPTIONS: Application of IFQs to Limited Entry Trawl Vessels Using **Longline and Fishpot (Fixed Gears) Without a Fixed Gear Endorsement.**

Option 1 - Require IFQ for Catch by Limited Entry Trawl Vessels Using **Longline or Fishpot Gear Without a Fixed Gear Endorsement**: IFQ tracking and monitoring rules would apply to limited entry trawl vessels even when using **longline or fishpot gear without an endorsement.**

SubOption 1A	Catch would be required to comply with **limited entry fixed gear** fishery catch control regulations.
SubOption 1B	Catch would be allowed in excess of **limited entry fixed gear** fishery catch control regulations, so long as landings are completely covered by trawl IFQ.

Option 2 - Require IFQ for Catch by Limited Entry Trawl Vessels Only When Using Groundfish Trawl Gear

SubOption 2A	• Split the groundfish trawl allocation between IFQ and non-IFQ harvest • Maintain the Amendment 6 accounting system and use nonIFQ management measures to control catch taken by trawl vessels with **longline or fishpot gears but no fixed gear endorsement**.
SubOption 2B	• Maintain the same limited entry allocation • Change the accounting system such that catch of limited entry trawl vessels using **fixed gears without a fixed gear endorsement** counts against **a limited entry fixed gear** allocation and apply **limited entry fixed gear** catch control regulations.
SubOption 2C	• Reallocate a portion of the limited entry **trawl sablefish** allocation to the **limited entry fixed gear** sector and **take into account trawl vessel harvest with fixed gear when establishing limited entry trawl/fixed gear allocations** • Change the accounting system such that catch of limited entry trawl vessels using **fixed gears without a fixed gear endorsement** counts against **a limited entry fixed gear** allocation and apply **limited entry fixed gear** catch control regulations.

The following table illustrates how each of the above options would work for an LE trawl vessel using an longline or fishpot gear in the open access fishery:

	Catch Counts Against	IFQ Must Be Held for Landing	Catch limits that apply
Suboption 1A	LE Allocation	Yes	IFQ and open access trip limits apply
Suboption 1B	LE Allocation	Yes	IFQ only
Suboption 2A	LE Allocation	No	Trip limits for LE use of open access gear apply
Suboption 2B	Fixed Gear Allocation	No	LE fixed gear limits apply
Suboption 2C	Augmented Fixed Gear Allocation	No	LE fixed gear limits apply

In the preceding tables, Option 2 provides a set of logically complete approaches for a system in which IFQ is not required for groundfish catch by LE trawl vessels using open access gears. To date, no one has advocated Suboption 2B. Changing the accounting system for LE trawl vessels would also beg the question of considering such a change for vessels with LE fixed gear permits and vessels with LE permits for both trawl and fixed gears.

Under current definitions, requirements under a groundfish trawl IFQ program would extend to limited entry trawl vessels using California halibut gear. However, California halibut trawl is legal groundfish trawl. When used by vessels without groundfish limited entry trawl permits, California halibut gear is considered an open access gear and IFQ would not be required under Option 2. Thus

two vessel could be fishing side by side using legal groundfish trawl and one be under the IFQ program and the other not, depending on whether or an LE permit is held for the vessel.

Trawl Vessel Catch of Trawl Prohibited Species Using Nontrawl Gear (IBQ)

The term "IBQ" is being used to refer to IFQ for trawl prohibited species. IBQ might be created to control harvest-related mortality for species such as halibut.

The following IBQ options have been considered:

IBQ Retention Options for Pacific Halibut	
IBQ Retention SubOption 1	No change in the retention rules.
IBQ Retention SubOption 2	Allow LE trawl vessels to retain Pacific halibut when covered by trawl IBQ for Pacific halibut **and caught with longline or other legal gear**. Adjust trawl Pacific halibut IBQ to account for 100% mortality.
IBQ Retention SubOption 3	Same as Option 2 plus, allow trawl IBQ for Pacific halibut to be transferred to vessels outside the LE Trawl fleet. (These nontrawl vessels would be allowed to retain Pacific halibut when covered by trawl IBQ for Pacific halibut and caught with legal halibut gear. Adjust trawl Pacific halibut IBQ to account for 100% mortality.)
IBQ Retention SubOption 4	Allow trawl vessels the opportunity to retain Pacific halibut caught with trawl gear and covered by trawl IBQ for Pacific halibut. Adjust trawl Pacific halibut IBQ to account for 100% mortality.)

In options 2 and 3, the retention would be in addition to that allowed while a vessel fished in common with other vessels using legal gear during Pacific halibut openings. A determination would be needed as to how that additional opportunity would be provided (through higher vessel limits or through retention opportunities outside the Pacific halibut openings.

Under IBQ Option 1, vessels would still be required to discard prohibited species caught while using trawl gear, but would have to stop fishing if they did not have IBQ to cover their bycatch. An issue with respect to IBQ is catch taken by trawl vessels when using gear that is legal for a trawl-prohibited species. In particular, can trawl vessels use IBQ to augment harvest opportunities for trawl prohibited species. For example, could LE trawl vessels use longline gear and retain halibut using their IBQ (Option 2), or could nontrawl vessels acquire trawl IBQ and augment their halibut longlining opportunity (Option 3)?

TIQC Recommendations:

IFQ Options for Trawl Vessel Use of Exempted Gear: With respect to exempted gears, the TIQC made a preliminary recommendation for open access gear Suboption 2C but included Options 1A and 1B the IFQ program alternatives it recommended for consideration. Suboption 2C would change the current system such that LE trawl vessels using open access gear would fish in common under regulations applying to the remainder of the open access fleet and their catch would be counted against the open access quota. Under the current system, all LE trawl vessel catch using open access gear counts against the LE trawl allocation. Consequently to accommodate the change in quota accounting under Suboption 2C there should be a reallocation of a small amount of trawl quota from the LE trawl fishery to the open access fishery. Under Suboption 2C all who fish with

open access gear would be treated the same. Any other option or suboption would create two classes of open access fishers fishing under different regulations.

The amount to be reallocated from trawl to the open access sector could be based on the catch of LE trawl vessels using open access gear during the period used to allocate IFQ, except that for shrimp trawlers, the reallocation should be based on the period after shrimp finfish excluders were required. The TIQC requested a forecast of the amount of fish that would be needed by LE trawl vessels using open access gear.

IFQ Options for Trawl Vessel Use of Longline and Fishpot Gear Without a Permit: The TIQC recommended consideration of only Suboptions 1A and 1B. Thus, their recommendation is that IFQ be required for any use of a gear covered by the limited entry program.

IBQ Retention Options: The TIQC included only IBQ Option1 in their IFQ programs recommended for analysis (and the option of status quo with respect to prohibited species management).

Options from Public Comment Period: None.

A.3.2 Initial Analysis

Use of Nontrawl Gear to Catch Groundfish

IFQ Options - Cost Issues

The coverage of the IFQ program needs to be reconciled with the current allocation accounting rules. If the current accounting rules are kept and the IFQ program covers the entire LE trawl vessel allocation (Option 1), then LE trawl vessels making groundfish landings in non-groundfish fisheries may need to make those landings in compliance with tracking and monitoring rules for the IFQ program including carrying an at-sea compliance monitor Requiring IFQ for open access fishery (OA) landings made by LE trawl vessels is likely to result in greater vessel costs for such vessels than for nonLE trawl vessels making similar OA landings. To mitigate some of the additional tracking and reporting burden, it might be possible to set up a system in which LE trawl vessels using open access gear would be subject to somewhat different tracking and monitoring rules. However, in considering these possibilities, the effect of the exceptions on opportunities and incentives to avoiding compliance would need to be considered.

Another possibility would be to develop enforcement and monitoring requirements for LE trawl vessel use of directed open access gear that are different from those for use of incidental open access gear. Under Option 1, LE trawl vessel use of directed open access gears might require compliance with the full monitoring provisions of the IFQ program, while use of incidental open access gears might trigger a lower level of monitoring, or application of an assumed groundfish bycatch rate. Information from the VMS and groundfish observer programs might be used to help divided the open access fleet into directed and incidental fisheries.[4/]

4/ Currently this distinction is not always apparent from examination of landings records.

Suboption 1A could generate enforcement complexities. Under Option 1A, vessels could fish with IFQs using open access gear but open access (or fixed gear limited entry) trip limits would apply. If this option is chosen, regulations will be needed to clearly distinguish a vessel's trips using open access gear from those made using limited entry trawl gear.

Ensuring LE trawl vessel compliance with IFQ tracking and monitoring rules while fishing with open access gear would result in additional costs for vessels and the tracking and monitoring system. Therefore, the option might be considered to not require IFQs for LE trawl vessels using open access gears (Option 2). However, Option 2 is likely to result in greater management costs. These would take the form of either: (a) increased costs associated with management of a separate set of very small subquotas for LE trawl vessels using open access gear (Suboption 2A), or (b) costs of reallocating and redefining the limited entry quota accounting rules such that open access catch by these vessels is merged into the management of another sector (Suboption 2C).

IFQ Options - Magnitude of Problem

Limited entry trawlers also engage in other fisheries, sometimes directly targeting groundfish species or taking groundfish as incidental catch. Data for 1998 indicate that 80 LE trawl vessels landed approximately 280,000 pounds of non-whiting groundfish using open access gear (Appendix H, Table 22). In 2003, 16 LE trawl vessels landed approximately 54,000 pounds of non-whiting groundfish using open access gear (Appendix H, Table 21).

The TIQC requested a forecast of the amount of fish that would be needed by LE trawl vessels using open access gear. However determination of "need" is not possible in this case because nothing restricts LE trawl vessels from participating in the open access fishery at any level of intensity subject to open access trip limits. There is not sufficient cost and revenue information available to attempt to make such a prediction; and an historical snapshot will not reveal longer term needs that may arise because there is not historic information on the magnitude and types of adjustments vessels may make in response to opportunities presented under an IFQ fishery. Another complication is that historic information is based on landings whereas the emerging management system is likely to be based on catch. Depending on the amount of discard, landings information may underestimate the amount of allocation would be needed to cover catch under the emerging management system.

IFQ Options - Spillover

Increased participation with open access gear may result from possible spillover from the IFQ program, either because IFQ becomes consolidated on fewer vessels such that some vessels divest themselves of LE permits and enter the open access fishery (either Options 1 or 2) or because vessels are able to more efficiently schedule their fishing activities to increase their participation in open access fisheries (only under Option 2).

A related concern has been voiced about the potential for trawl vessel spillover into the LE fixed gear fishery. Trawl vessel participation in the open access portion of the fishery could be constrained by prohibiting their use of longline or fishpot gear as an open access gear. Trawl vessels desiring to use these gears could then acquire limited entry longline or fishpot permits. The ability

of these vessels to expand their catch would be limited because under the current system vessels accumulating fixed gear permits for species other than sablefish still only get access to a single trip limit. Where a vessel is licensed for both trawl and longline or fishpot, the more liberal trip limit constraints would apply. Vessels would be able to fish up to the more conservative trip limit with either gear and then take any additional fish with the gear to which the more liberal limits applied. (The sablefish component of the fishery is already managed under an IFQ-type program.)

IFQ Options - Habitat Impacts

If LE trawl vessels are required to hold IFQ to cover their catch made with open access gear, a significant new policy option opens up, i.e. the potential to allow trawl vessels to use non trawl gear to take their IQ. For both the exempted gears and longline and fishpot gears, Suboptions 1A and 1B are apparently consistent with the provisions in the EFH EIS preferred alternatives, which propose to foster reduction in the use of gears with adverse habitat impacts by allowing LE vessels to catch their groundfish allocation with gears for which they do not hold endorsements. Suboption 1B would be more likely to foster such conversion as vessels catching groundfish using their IFQ would not be constrained by the trip limits for the open access gear.

IFQ Options - Types of Open Access Gear Used by LE Trawlers

The following table lists the open access gear types used to land groundfish in 2002 by vessels that had limited entry trawl permits. Note that gear used to land California halibut is considered groundfish trawl gear and does not appear in this list.

PacFIN Gear ID (GRID)	Description
BMT	beam trawl
CLP	crab and lobster pot
CPT	crab pot
DNT	danish/scottish seine (trawl)
DPN	dipnet
DST	shrimp trawl, double rigged
DVG	diving gear
FPT	fish pot
GLN	gillnet
LGL	longline
POL	pole
PRW	prawn trap
SHT	shrimp trawl, single or double rigged
SST	shrimp trawl, single rigged
TRL	troll
USP	unknown or unspecified gear
VHL	vertical hook and line

IFQ Options - Landed Incidental Catch in the Shrimp Fishery

The following table was produced in response to a TIQC request and shows the amount of groundfish landed in 2002 using shrimp trawl gear by vessels with and without LE trawl permits.

SPID	Common Name	LE Total (mt)	non-LE Total (mt)	Total (mt)
LCOD	LINGCOD	1.6	4.8	6.4
PCOD	PACIFIC COD	0.0	0.1	0.1
SABL	SABLEFISH	4.3	9.6	13.9
WDW1	NOM. WIDOW ROCKFISH	0.1	0.1	0.2
CNR1	NOM. CANARY ROCKFISH	0.2	1.0	1.2
CNRY	CANARY ROCKFISH	0.0	0.1	0.1
CLP1	NOM. CHILIPEPPER	0.3	0.1	0.3
BCC1	NOM. BOCACCIO	0.0	0.1	0.1
DBR1	NOM. DARKBLOTCHED ROCKFISH	0.0	0.6	0.6
BNK1	NOM. BANK ROCKFISH	0.1	0.0	0.1
BGL1	NOM. BLACKGILL ROCKFISH	0.2	0.0	0.2
YTR1	NOM. YELLOWTAIL ROCKFISH	4.6	18.1	22.7
YTRK	YELLOWTAIL ROCKFISH	0.4	2.3	2.7
NUSP	NOR. UNSP. SLOPE ROCKFISH	0.0	0.2	0.2
NUSF	NOR. UNSP. SHELF ROCKFISH	0.1	0.2	0.3
RCK4	UNSP. REDS RCKFSH	0.0	0.1	0.2
SCOR	CALIFORNIA SCORPIONFISH	0.0	1.1	1.1
URCK	UNSP. ROCKFISH	0.0	0.3	0.3
DOVR	DOVER SOLE	2.6	7.3	9.9
EGLS	ENGLISH SOLE	3.9	1.0	4.9
PTRL	PETRALE SOLE	7.2	1.6	8.9
ARTH	ARROWTOOTH FLOUNDER	0.0	0.7	0.7
UDAB	UNSP. SANDDABS	3.9	0.1	4.0
REX	REX SOLE	2.1	0.7	2.7
STRY	STARRY FLOUNDER	0.0	0.2	0.2
UFLT	UNSP. FLATFISH	0.0	4.9	4.9
LSRK	LEOPARD SHARK	0.0	0.1	0.1
SSRK	SOUPFIN SHARK	0.0	0.1	0.1
	TOTAL GROUNDFISH	31.8	55.3	87.2

IFQ Options - Equity Considerations

Link to Allocation Rule

Allocating IFQ based on a landings history that includes groundfish bycatch in the pink shrimp fishery, and then allowing LE permitted vessels to take groundfish bycatch in the pink shrimp fishery but not use IFQ to cover it might be considered double dipping (i.e., the vessel would take groundfish as bycatch, in common with other pink shrimp vessels, but also receive an allocation of IFQ based on groundfish caught in the pink shrimp fishery). This issue can be addressed in the allocation formula.

Operational Cost Burdens

If all IFQ landings must be made in compliance with the monitoring system, then the IFQ vessel making shrimp landings would incur greater operational costs than non-IFQ vessels participating in the shrimp fishery.

IFQ Options - Vessels with both Trawl and Fixed Gear Permits

An additional complication arises for vessels with LE permits endorsed for both trawl and fixed (fishpot or longline) gear. Presumably, under a new program the current LE allocation will be split between trawl and fixed gear and the gear used on the trip would determine which quota and requirements apply. However if one of these dual gear LE vessels uses open access gear, a determination will be needed on whether the catch would count against the limited entry trawl, limited entry fixed gear or open access allocations. In 2004 there were five vessels carrying combined trawl/fixed gear LE permits.

IBQ Options - Halibut

Creation of IBQ for Pacific halibut would require prior consultation with the IPHC. In the BC IFQ system, IBQ for trawl caught halibut has substantially reduced halibut bycatch. The IFQ program being considered here includes an option that would allow the retention of halibut when covered with IBQ and caught with legal halibut gear (IBQ Retention Option 2). If the monitoring system is adequate to ensure all catch is accounted for, allowing the transfer of IBQ to a sector that is allowed to harvest and retain that catch (IBQ Retention Option 3) would likely reduce discards and increase utilization of the IBQ species. Currently the assumed bycatch discard mortality rate for halibut caught (as a prohibited species) by the trawl sector is less than 100%. Obviously, mortality would be 100% in a retention fishery. Hence if the program allowed retention of halibut caught against IBQ (IBQ Retention Option 2 or 3), the amount of halibut mortality represented by a given amount of IBQ would be greater under the retention fishery. Amounts of IBQ issued would be need to be adjusted to take into account the higher mortality rate. Rather than involving another sector in the tracking and monitoring program, trawl vessels might be allowed to retain halibut covered with IBQ when (1) the catch is taken with legal halibut gear, and (2) adjustment to the IBQ pounds are made to account for the higher mortality rate. In whatever mode the halibut IBQ is taken (trawl or nontrawl vessels using legal halibut gear) a question to be addressed is How will the use of halibut IBQ augment the harvest opportunity the vessels would have operating in common with other vessels using legal gear? Would it provide opportunity outside the normal commercial season or higher limits within the season?

If the system were designed such that IBQ for halibut were converted to IFQ for the trawl fishery (i.e., trawl vessels would be allowed to retain halibut caught with trawl gear), the halibut catch sharing plan would need to be modified and approval would be required by the IPHC. A June 30, 2004 letter to the Council from IPHC Executive Director Bruce Leaman observed "Recent proposals to the Commission requesting trawl retention of halibut have not been approved, so it is unlikely that the Commission would adopt this proposal."

IBQ Options - Salmon

Creation of IBQ for salmon would require consideration of variations in the contribution of different stock to the salmon catch during a particular year, time and area. Coordinating management of salmon IBQ with annual salmon stock and run management could become complex. Also, salmon IBQ, if issued for individual runs, may be so small as to become very limiting on trawl activities at certain times and areas.

IBQ Options - Dungeness Crab

Dungeness crab is not currently managed under a quota, therefore some artificial bycatch quota would have to be established to create crab IBQ. Currently crab is managed using season and size restrictions.

Figure A1. Groundfish management areas off the West Coast of Canada.

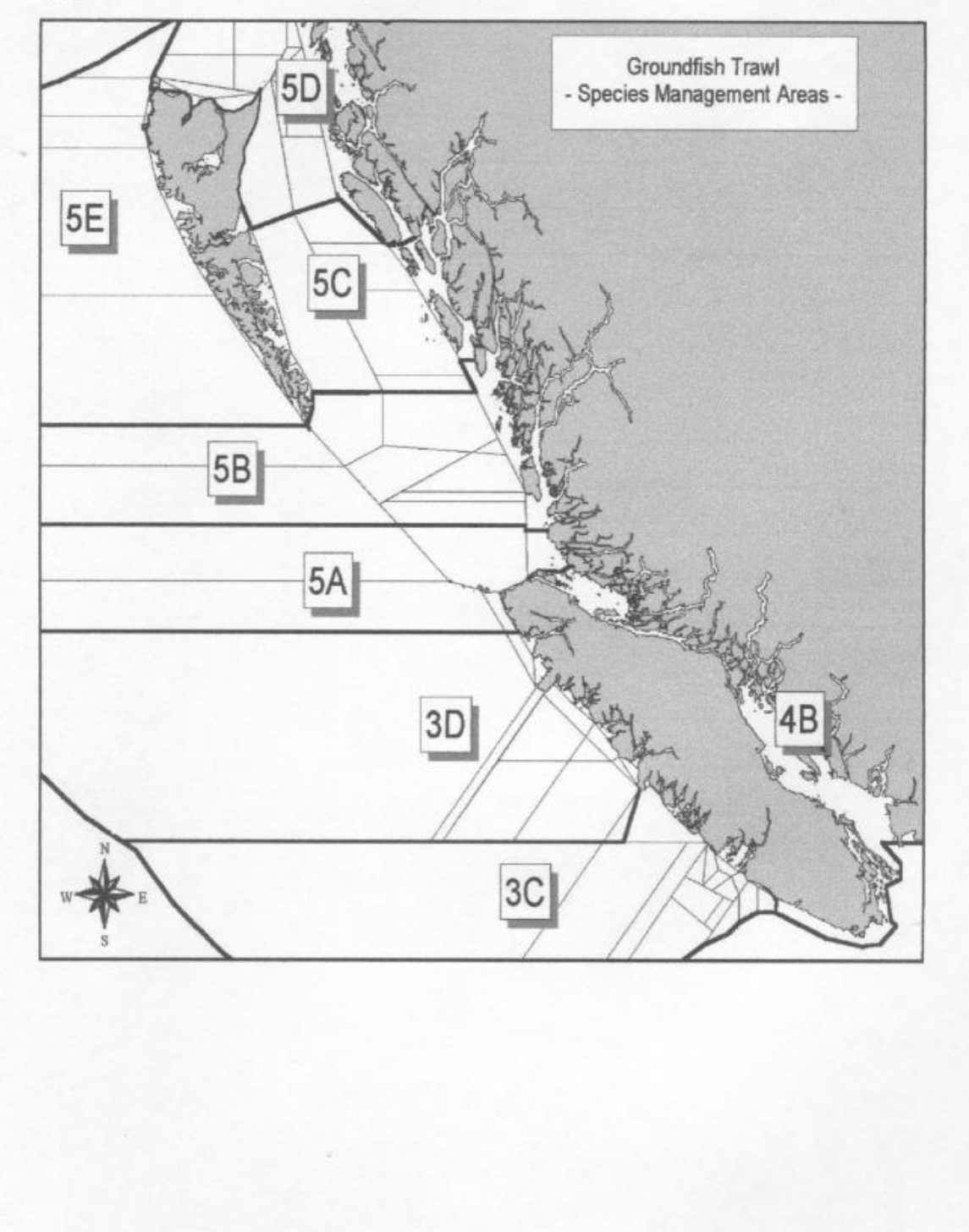

Table A1. Total allowable catches (TAC) of groundfish by British Columbia management area.

Species	Management Area	TAC (mt)
Yellowtail Rockfish	3C	995
	3D, 5A/5B, 5C/D/E	3,427
Widow Rockfish	Coastwide	4,422
Canary Rockfish	3C/D	529
	5A/B	265
	5C/D	101
	5E	151
Silvergrey Rockfish	3C/D	216
	5A/B	421
	5C/D	382
	5E	248
Pacific Ocean Perch	3C	300
	3D	230
	5A/B	2,070
	5C/D	2,818
	5E	730
Yellowmouth Rockfish	3C	219
	3D, 5A/5B	1,135
	5C/D	685
	5E	325
Rougheye Rockfish	Coastwide	530
Shortraker Rockfish	Coastwide	105
Redstripe Rockfish	3C	173
	3D,5A/B	772
	5C/D	330
	5E	246
Shortspine Thornyheads	Coastwide	736
Longspine Thornyheads	Coastwide	405
Qullback, Copper, China, and Tiger Rockfish	Coastwide	5
Pacific Cod	3C/D	500
	5A/B	390
	5C/D/E	400
Dover Sole	3C/D	1,375
	5C/D/E	1,100
Rock Sole	3C/D	102
	5A/B	875
	5C/D	673
Lemon Sole	3C/D	186
	5C/D/E	544
Petrale Sole	Coastwide	600
Lingcod	3C	800
	3D	220
	5A/B	862
	5C/D/E	580
Dogfish	4B	1,600
	Rest of Coast	3,840
Sablefish	Coastwide	384
Pollock	Gulf	1,115
	5A/B	1,790
Hake	Gulf	10,000
	Offshore	134,372
Big Skate	5C/D	567
Longnose skate	5C/D	47

References

Berkeley, S. A. 2004. Maternal age as a determinant of larval growth and survival in a marine fish, *Sebastes melanops*. Ecology 85(5):1258-1264.

Berkeley, S. A., M. A. Hixon, R. J. Larson, and M. S. Love. 2004. Fisheries sustainability via protection of age structure and spatial distribution of fish populations. Fisheries 29(8):23-32.

Bobko, S. J., and S. A. Berkeley. 2004. Maturity, ovarian cycle, fecundity, and age-specific parturition of black rockfish, *Sebastes melanops.* Fish. Bull. 102(3):418-429.

DFO (Department of Fisheries and Oceans Canada). 2004. Pacific Region Integrated Fisheries Management Plan Groundfish Trawl April 1, 2004 to March 31, 2005.

Francis, B. 2003. A web of small tensions. Fisheries 28(2):20-23.

Gabriel, W., and A. V. Tyler. 1980. Preliminary analysis of Pacific coast demersal fish assemblages. Mar. Fish. Rev. 42(3-4):83-88.

Hutchings, J. A., and R. A. Myers. 1994. What can be learned from the collapse of a renewable resource, Atlantic cod, *Gadus morhua*, of Newfoundland and Labrador? Can. J. Fish. Aquat. Sci. 51:2126-2146.

Lee, Y. W. 1997. Using Oregon trawl logbooks to study spatial and temporal characteristics of commercial groundfish species associations. Master of Science. Oregon State University, Corvallis, Oregon.

Mason, J. E. 1995. Species trends in sport fisheries, Monterey Bay, Calif., 1959-86. Mar. Fish. Rev. 7(1):1-16.

Miller, J. A., and A. L. Shanks. 2004. Evidence for limited larval dispersal in black rockfish (*Sebastes melanops*): implications for population structure and marine-reserve design. Can. J. Fish. Aquat. Sci. 61:1723-1735.

Mueter, F.-J. 1999. Spatial and temporal patterns in the Gulf of Alaska groundfish community in relation to the environment. Doctor of Philosophy. University of Alaska, Fairbanks, Alaska.

Murawski, S. A., P. J. Rago, and E. A. Trippel. 2002. Impacts of demographic variation in spawning characteristics on reference points for fishery management. ICES J. of Mar. Sci. 58:1002-1014.

PFMC (Pacific Fishery Management Council). 2004. Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures: 2005-2006 Pacific Coast Groundfish Fishery; Final Environmental Impact Statement Including Regulatory Impact Review and Initial Regulatory Flexibility Analysis. Pacific Fishery Management Council, Portland, OR, October 2004.

PFMC (Pacific Fishery Management Council). 2004e. Proposed groundfish acceptable biological catch and optimum yield specifications and management measures 2005-2006 Pacific Coast groundfish fishery, Portland, OR.

Punt, A. E., and R. D. Methot. 2004. Effects of marine protected areas on the assessment of marine fisheries. American Fisheries Society Symposium 42:133-154.

Walters, C. J., and P. H. Pearse. 1996. Stock information requirements for quota management systems in commercial fisheries. Reviews in Fish Biology and Fisheries 6:21-42.

Weinberg, K. L. 1994. Rockfish assemblages of the middle shelf and upper slope off Oregon and Washington. Fish. Bull. 92:620-632.

Witherell, D. B. 1995. Management of flatfish fisheries in the North Pacific. Pages 573-589 *in* Proceedings of the International Symposium on North Pacific Flatfish, volume AK-SG-95-04. Alaska Sea Grant College Program, Anchorage, Alaska.